FORM PTO-1390 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE
(REV 11-98)

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	
28490.2500	
U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.5)	
10/019830	

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/KR00/00039	2 JANUARY 2000	11 MAY 1999

TITLE OF INVENTION
ELECTROMAGNETIC SWITCH DEVICE

APPLICANT(S) FOR DO/EO/US
PARK, Young Seo

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3))
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ Certificate of Mailing by Express Mail
20. ☐ Other items or information:

1) Copy of Article 34 Amendment to specification, claims, and drawings; the amended specification and drawings, as well as the three amended claims (numbered 1, 5 and 6) are to be the subject of the U.S. application.

2) Verified Statement Claiming Small Entity Status

3) Power of Attorney and Designation of Domestic Representative of Assignee Company

4) Return Receipt Postcard

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/019830	PCT/KR00/00039	28490.2500

21. The following fees are submitted:.

CALCULATIONS PTO USE ONLY

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

- ☒ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**

ENTER APPROPRIATE BASIC FEE AMOUNT = **$1,000.00**

Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)). **$0.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	3 - 20 =	0	x $18.00	**$0.00**
Independent claims	1 - 3 =	0	x $80.00	**$0.00**
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**

TOTAL OF ABOVE CALCULATIONS = **$1,000.00**

Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)**. ☒ **$500.00**

SUBTOTAL = **$500.00**

Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). + **$0.00**

TOTAL NATIONAL FEE = **$500.00**

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable)**. ☒ **$40.00**

TOTAL FEES ENCLOSED = **$540.00**

Amount to be: refunded	$
charged	$

- ■ A check in the amount of **$540.00** to cover the above fees is enclosed.
- ■ Please charge my Deposit Account No. in the amount of to cover the above fees. A duplicate copy of this sheet is enclosed.
- ■ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **19-2814** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Cynthia L. Pillote, Esq.
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Phoenix, Arizona 85004-2202

SIGNATURE

Cynthia L. Pillote
NAME

42,999
REGISTRATION NUMBER

November 7, 2001
DATE

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27 (c)) - SMALL BUSINESS CONCERN	Docket No. 28490.2500

Serial No.	Filing Date	Patent No.	Issue Date

Applicant/ Patentee: **Assignee: Intervention Co., Ltd.**
Inventor: PARK, Young Seo

Invention: **ELECTROMAGNETIC SWITCH DEVICE**

I hereby declare that I am:

- ☐ the owner of the small business concern identified below:
- ☐ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN: **Intervention Co., Ltd.**
ADDRESS OF CONCERN: **49-21, Sajik 1-dong, Dongrae-ku, Pusan 607-121, KOREA**

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined i 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) an (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concer is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time c temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other whe either, directly or indirectly, one concern controls or has the power to control the other, or a third party or partie controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small busines concern identified above with regard to the above identified invention described in:

- ☒ the specification filed herewith with title as listed above.
- ☐ the application identified above.
- ☐ the patent identified above.

If the rights held by the above-identified small business concern are not exclusive, each individual, concern c organization having rights to the invention is listed on the next page and no rights to the invention are held by an person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) or by an concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization unde 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under a obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- [x] no such person, concern or organization exists.
- [ ] each such person, concern or organization is listed below.

FULL NAME _____
ADDRESS _____

[ ] Individual [ ] Small Business Concern [ ] Nonprofit Organization

FULL NAME _____
ADDRESS _____

[ ] Individual [ ] Small Business Concern [ ] Nonprofit Organization

FULL NAME _____
ADDRESS _____

[ ] Individual [ ] Small Business Concern [ ] Nonprofit Organization

FULL NAME _____
ADDRESS _____

[ ] Individual [ ] Small Business Concern [ ] Nonprofit Organization

Separate verified statements are required from each named person, concern or organization having rights to tl invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or a maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made information and belief are believed to be true; and further that these statements were made with the knowledge th willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of tl application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: KWON, Su Young
TITLE OF PERSON SIGNING OTHER THAN OWNER: President
ADDRESS OF PERSON SIGNING: 16-311 Siyoung APT., 10-6, Sajik 2-dong, Dongrae-ku Pusan 607-122, KOREA

SIGNATURE: _____ DATE: Nov. 1, 2001

5/prts

A MAGNETIC CONTACTOR FOR STAR-DELTA CONNECTIONS

Technical Field

The present invention relates to a magnetic contactor(electromagnetic switch device) for star-delta connections, and more particularly to an electromagnetic switch device designed to be used for a star-delta starter adapted to start up a three-phase electric motor in order to allow the motor to be driven at its full speed within a short period of time.

Background Art

As well known, star (Y)-delta (Δ) starters, which are used to start up an electric motor, serve to establish a star connection for the electric motor upon the start-up of the electric motor, thereby reducing starting current and starting torque required in the start-up of the electric motor to a 1/3 level, while switching the connection for the electric motor into a delta connection after completion of the start-up of the electric motor so that the electric motor is driven in the delta connection state. Such star-delta starters are widely used in a variety of industrial fields in order to protect electric motors and peripheral devices thereof from overload.

Star-delta starters are classified into a contact type using an electromagnetic switch device adapted to switch

electric contacts by use of electromagnets, and a non-contact type using a semiconductor switch device. The type using an electromagnetic switch device is more widely used.

Figs. 1a, 1b and 2 illustrate a conventional electromagnetic switch device and a star-delta starter using the electromagnetic switch device, respectively. Fig. 1a is a perspective view illustrating the electromagnetic switch device, and Fig. 1b is a cross-sectional view taken along the line A - A of Fig. 1a. Fig. 2 is an equivalent circuit diagram illustrating the star-delta starter.

As shown in Figs. 1a and 1b, the conventional electromagnetic switch device, which is denoted by the reference character C, includes a body 1, and a cover 2 separably attached to an upper surface 1a of the body 1. Three pairs of terminals 3 are disposed on the upper surface 1a of the body 1 in such a fashion that the terminals of each terminal pair are arranged at opposite sides of the body 1, respectively, while being insulated from one another. Electric power lines not shown are connected to the terminals 3, respectively. Isolating plates 4 are arranged at opposite sides of the cover 2 to isolate adjacent ones of the terminals 3.

Three pairs of fixed contacts 5 are also provided. Each fixed contact 5 is arranged at an end of an associated one of the terminals 3 extending toward a central portion of the body 1. The fixed contacts 5 are insulated from one another. A

vertical moving member 6 is arranged at the central portion of the body 1 in such a fashion that it is upwardly and downwardly movable. Three pairs of moving contacts 7 insulated from one another are mounted to the vertical moving member 6 at opposite sides of the vertical moving member 6 in such a fashion that each of the moving contacts 7 selectively comes into contact with an associated one of the fixed contacts 5 so that it is short-circuited or opened with respect to the associated fixed contact 5. A compression coil spring 8 is arranged around the vertical moving member 6 between the upper surface 1a of the body 1 and the moving contacts 7 in such a fashion that it always urges the vertical moving member 6 upwardly.

A fixed core 9 is arranged at a lower portion of the body 1. A coil 10 is wound around the fixed core 9 in order to form an electromagnet. Above the fixed core 9, a moving core 11 is arranged in such a fashion that it moves vertically along with the vertical moving member 6 in accordance with a magnetization of the electromagnet.

The conventional star-delta starter using electromagnetic switch devices having the above mentioned configuration includes an electromagnetic switch device C1 for a main circuit, an electromagnetic switch device C2 for a star circuit, and an electromagnetic switch device C3 for a delta connection, which are connected together as shown in the equivalent circuit diagram of Fig. 2 and activated by a timer (not shown) to start

up a three-phase electric motor M.

When current flows through the coil 10 of the electromagnetic switch device C2 for the star circuit upon starting the three-phase electric motor M, the electromagnet formed by the fixed core 9 and coil 10 is magnetized by virtue of the current.

Accordingly, the electromagnet generates a magnetic force greater than the resilience of the spring 8, so that the vertical moving member 6 and moving core 11 are downwardly moved. As a result, the moving contacts 7, which also move downwardly, come into contact with the fixed contacts 5, respectively.

When the electromagnetic switch device C1 for the main circuit is activated in accordance with the same procedure as mentioned above, a star connection is established for the three-phase electric motor M, so that the three-phase electric motor M is started up using starting current and starting torque reduced to a 1/3 level. At the same time, the timer not shown begins to operate in order to count the drive time of the three-phase electric motor M.

After a predetermined period of time elapses, the current flowing through the coil 10 of the electromagnetic switch device C2 for the star connection is cut off by an operation of the timer. At the same time, current flows through the coil 10 of the electromagnetic switch device C3 for the delta connection.

In this state, the magnetic force of the electromagnet formed by the fixed core 9 and coil 10 of the electromagnetic switch device C2 for the star connection disappears. As a result, the vertical moving member 6 is upwardly moved along with the moving core 11 and moving contacts 7 by virtue of the resilience of the spring 8, thereby causing the moving contacts 7 to be separated from the fixed contacts 5.

Meanwhile, the electromagnet formed by the fixed core 9 and coil 10 of the electromagnetic switch device C3 for the delta connection is magnetized by virtue of the current flowing through the coil 10. As a result, the moving contacts 7 are downwardly moved, so that they come into contact with the fixed contacts 5, respectively.

Accordingly, the electromagnetic switch device C3 for the delta connection is short-circuited to electric power lines at its one-side terminals 3. As a result, the three-phase electric motor M is switched to the star connection state to a delta connection state, so that it is driven at a full speed.

In the star-delta starter having the above mentioned configuration, each of its electromagnetic switch devices is used only for a single purpose, that is, a star connection or a delta connection. For this reason, the conventional star-delta starter cannot implement a desired system unless at least two electromagnetic switch devices are used, even when those used for the main circuit are not taken into consideration.

As a result, the conventional star-delta starter involves high manufacturing and installing costs and a large occupation space.

The conventional star-delta starter also involves a complex wiring for the connection between the electric motor and the electromagnetic switch device used. Such a complex wiring may result in a possibility of erroneous connections. In particular, such a wiring may be easily damaged by an external force applied thereto, thereby resulting in an erroneous operation of the starter or a damage of the electric motor.

Disclosure of Invention

Therefore, an object of the invention is to solve the above mentioned problems involved in the prior art, and to provide an electromagnetic switch device for star-delta connections which includes two electromagnets arranged in its body and two switching units operating in accordance with respective magnetization states of the electromagnets in order to selectively establish a star connection or a delta connection for a three-phase electric motor, so that it can reduce installation costs and an occupation space when it is applied to a star-delta starter while using no unnecessary wiring, thereby reducing erroneous connections and erroneous operations.

In accordance with the present invention, this object is accomplished by providing an electromagnetic switch device for

star-delta connections comprising: a body; three power terminals arranged at one side of the body and respectively connected to three-phase power lines, the power terminals being insulated from one another; three main starting terminals arranged at the other side of the body and respectively connected to one-side terminals of a three-phase electric motor, the main starting terminals being insulated from one another; three star-delta terminals arranged at the other side of the body outside the main starting terminals and connected to the other-side ends of the three-phase electric motor, respectively, the star-delta terminals being insulated from one another; an electromagnet for a main circuit and an electromagnet for star-delta connections disposed at a lower portion of the body in such a fashion that they are laterally aligned with each other while being insulated from each other, each of the electromagnets including a fixed core and a coil wound around the fixed core; a main circuit switching unit arranged near the main circuit-end electromagnet in the interior of the body, the main circuit switching unit serving to selectively connect each of the main starting terminals to an associated one of the power terminals in accordance with a magnetization of the main circuit-end electromagnet; and a star-delta connection switching unit arranged near the star-delta connection-end electromagnet in the interior of the body, the star-delta connection switching unit serving to selectively connect the star-delta terminals to one

another or to the main starting terminals, respectively, in accordance with a magnetization of the star-delta connection-end electromagnet.

Preferably, the electromagnetic switch device further comprises a timer arranged in the interior of the body and adapted to count an activation time of the main circuit-end electromagnet, thereby determining a point of time when the star-delta connection-end electromagnet is to be activated.

The electromagnetic switch device may further comprise isolating plates arranged between adjacent ones of the power terminals, between adjacent ones of the main starting terminals, and between adjacent ones of the star-delta terminals to isolate the adjacent power terminals, the adjacent main starting terminals, and the adjacent star-delta terminals, respectively.

The main circuit switching unit may comprise: a moving core vertically movable in accordance with a magnetization of the main circuit-end electromagnet; a vertical moving member integrally coupled to the moving core in such a fashion that it is moved along with the moving core; three pairs of fixed contacts arranged at desired positions within a vertical movement zone of the vertical moving member in such a fashion that the fixed contacts included in each of the fixed contact pairs are disposed at opposite sides of the vertical moving member, respectively, the fixed contacts arranged at one side of the vertical moving member being connected to the power

terminals, respectively, while being insulated from one another, and the fixed contacts arranged at the other side of the vertical moving member being connected to the main starting terminals, respectively, while being insulated from one another; and three pairs of moving contacts mounted to the vertical moving member in such a fashion that the moving contacts included in each of the moving contact pairs are disposed at opposite sides of the vertical moving member, respectively, the moving contacts arranged at one side of the vertical moving member being insulated from one another, the moving contacts arranged at the other side of the vertical moving member being insulated from one another, and the moving contacts being vertically moved in accordance with a vertical movement of the vertical moving member, so that they selectively come into contact with respective associated ones of the fixed contacts, thereby causing the power terminal-end fixed contacts to be selectively connected to the starting terminal-end fixed contacts.

The star-delta connection switching unit may comprise: a moving core vertically movable in accordance with a magnetization of the star-delta connection-end electromagnet; a vertical moving member integrally coupled to the moving core in such a fashion that it is moved along with the moving core; three pairs of fixed contacts for star-delta connection arranged at desired positions within a vertical movement zone of the

vertical moving member in such a fashion that the fixed contacts included in each of the fixed contact pairs are disposed at opposite sides of the vertical moving member, respectively, the fixed contacts arranged at one side of the vertical moving member being connected to the main starting terminals, respectively, while being insulated from one another, and the fixed contacts arranged at the other side of the vertical moving member being connected to the star-delta terminals, respectively, while being insulated from one another; three pairs of moving contacts for delta connection mounted to the vertical moving member in such a fashion that the moving contacts included in each of the moving contact pairs are disposed at opposite sides of the vertical moving member, respectively, the moving contacts arranged at one side of the vertical moving member being insulated from one another, the moving contacts arranged at the other side of the vertical moving member being insulated from one another, and the moving contacts being vertically moved in accordance with a vertical movement of the vertical moving member, so that they selectively come into contact with respective associated ones of the fixed contacts, thereby causing the star-delta connection-end fixed contacts to be selectively connected to the starting terminal-end fixed contacts so as to achieve a delta connection; and three moving contacts for star connection mounted to the vertical moving member at a position vertically shifted from the

delta connection-end moving contacts near the star-delta connection-end fixed contacts, the star connection-end moving contacts being short-circuited together, and the star connection-end moving contacts being vertically moved in accordance with a vertical movement of the vertical moving member, so that they selectively come into contact with respective associated ones of the fixed contacts, thereby causing the fixed contacts to be selectively connected together so as to achieve a star connection, the star connection by the star connection-end moving contacts being achieved when the delta connection by the delta connection-end moving contacts is released.

Each of the main circuit switching unit and star-delta connection switching unit may further comprise a return springs adapted to provide a return force for returning the associated vertical moving member to an original position thereof at which the associated moving contacts are separated from respective associated ones of the fixed contacts.

Each of the main circuit switching unit and star-delta connection switching unit may further comprise an arc prevention spring arranged in the associated vertical moving member and adapted to always urge the associated moving contacts toward the associated fixed contacts, thereby increasing the contact force of the moving contacts when the moving contacts come into contact with the fixed contacts, so as to suppress generation of

arc at regions where the moving contacts come into contact with the fixed contacts, respectively.

Brief Description of Drawings

The above objects, and other features and advantages of the present invention will become more apparent after a reading of the following detailed description when taken in conjunction with the drawings, in which:

Figs. 1a, 1b and 2 illustrate a conventional electromagnetic switch device and a star-delta starter using the electromagnetic switch device, respectively, wherein Fig. 1a is a perspective view illustrating the electromagnetic switch device, Fig. 1b is a cross-sectional view taken along the line A - A of Fig. 1a, and Fig. 2 is an equivalent circuit diagram illustrating the star-delta starter; and

Figs. 3a, 3b and 4 illustrate an electromagnetic switch device according to the present invention and a star-delta starter u usithe electromagnetic switch device, respectively, wherein Fig. 3a is a perspective view illustrating the electromagnetic switch device, Fig. 3b is a cross-sectional view taken along the line A - A of Fig. 3a, and Fig. 4 is an equivalent circuit diagram illustrating the star-delta starter using the electromagnetic switch device according to the present invention.

Best Mode for Carrying Out the Invention

Figs. 3a, 3b and 4 illustrate an electromagnetic switch device according to the present invention and a star-delta starter using the electromagnetic switch device, respectively. Fig. 3a is a perspective view of the electromagnetic switch device, and Fig. 3b is a cross-sectional view taken along the line A - A of Fig. 3a. Fig. 4 is an equivalent circuit diagram of the star-delta starter using the electromagnetic switch device according to the present invention.

As shown in Figs. 3a and 3b, the electromagnetic switch device of the present invention, which is denoted by the reference character C, includes a body 110, and three power terminals 121a, 121b, and 121c arranged at one side of the body 110 and respectively connected to three-phase power lines R, S, and T. The power terminals 121a, 121b, and 121c are insulated from one another. The electromagnetic switch device also includes three main starting terminals 122a, 122b, and 122c arranged at the other side of the body 110 and respectively connected to one-side terminals u, v, and w of a three-phase electric motor M. The main starting terminals 122a, 122b, and 122c are insulated from one another. Three star-delta terminals 123a, 123b, and 123c are arranged at the other side of the body 110 outside the main starting terminals 122a to 122c. The star-delta terminals 123a, 123b, and 123c are connected to the other-side ends Z, X, and Y of the three-phase electric motor M,

respectively. The star-delta terminals 123a, 123b, and 123c are insulated from one another.

An electromagnet 130 for a main circuit and an electromagnet 140 for star-delta connections are disposed at a lower portion of the body 110 in such a fashion that they are laterally aligned with each other while being insulated from each other. The electromagnet 130 includes a fixed core 131 and a coil 132 whereas the electromagnet 140 includes a fixed core 141 and a coil 142.

The electromagnetic switch device also includes a main circuit switching unit 150 arranged above the main circuit-end electromagnet 130 in the interior of the body 110. The main circuit switching unit 150 serves to selectively connect the main starting terminals 122a, 122b, and 122c to respective power terminals 121a, 121b, and 121c in accordance with a magnetization of the electromagnet 130. The main circuit switching unit 150 includes a main circuit-end moving core 151 and a main circuit-end vertical moving member 152 integrally coupled together and arranged above the main circuit-end electromagnet 130 near the main circuit-end electromagnet 130. The moving core 151 and vertical moving member 152 are adapted to be moved together in accordance with a magnetization of the electromagnet 130. The main circuit switching unit 150 also includes three pairs of main circuit-end fixed contacts 153a, 153b, and 153c arranged at desired

positions within a vertical movement zone of the main circuit-end vertical moving member 152 in such a fashion that the fixed contacts of each fixed contact pair are disposed at opposite sides of the vertical moving member 152, respectively. The fixed contacts 153a, 153b, and 153c arranged at one side of the vertical moving member 152 are connected to the power terminals 121a, 121b, and 121c, respectively, while being insulated from one another. The fixed contacts 153a, 153b, and 153c arranged at the other side of the vertical moving member 152 are connected to the main starting terminals 122a, 122b, and 122c, respectively, while being insulated from one another. Three pairs of moving contacts 154a, 154b, and 154c are mounted to the main circuit-end vertical moving member 152 in such a fashion that the moving contacts of each moving contact pair are disposed at opposite sides of the vertical moving member 152, respectively. The moving contacts 154a, 154b, and 154c arranged at one side of the vertical moving member 152 are insulated from one another. In similar, the moving contacts 154a, 154b, and 154c arranged at the other side of the vertical moving member 152 are insulated from one another. The moving contacts 154a, 154b, and 154c are vertically moved in accordance with a vertical movement of the vertical moving member 152, so that they selectively come into contact with respective associated ones of the fixed contacts 153a, 153b, and 153c, thereby causing the power terminal-end fixed contacts 153a, 153b, and 153c to be

selectively connected to the starting terminal-end fixed contacts 153a, 153b, and 153c.

Return springs 155 are arranged around the moving core 151 between the upper surface of the main circuit-end electromagnet 130 and the lower surface of the main circuit-end vertical moving member 152 in order to provide a return force for returning the vertical moving member 152 to its original position at which the moving contacts 154a, 154b, and 154c are separated from respective associated ones of the fixed contacts 153a, 153b, and 153c. An arc prevention spring 156 is arranged in the main circuit-end vertical moving member 152 in order to always urge the moving contacts 154a, 154b, and 154c toward the fixed contacts 153a, 153b, and 153c, thereby increasing the contact force of the moving contacts 154a, 154b, and 154c when the moving contacts 154a, 154b, and 154c come into contact with the fixed contacts 153a, 153b, and 153c, so as to suppress generation of arc at those contacts.

The electromagnetic switch device further includes a star-delta connection switching unit 160 arranged above the star-delta connection-end electromagnet 140 in the interior of the body 110. The star-delta connection switching unit 160 serves to selectively connect the star-delta terminals 123a, 123b, 123c to one another or to respective main starting terminals 122a, 122b, and 122c in accordance with a magnetization of the star-delta connection-end electromagnet 140.

The star-delta connection switching unit 160 includes a star-delta connection-end moving core 161 and a star-delta connection-end vertical moving member 162 integrally coupled together and arranged above the star-delta connection-end electromagnet 140 near the star-delta connection-end electromagnet 140. The moving core 161 and vertical moving member 162 are adapted to be moved together in accordance with a magnetization of the electromagnet 140. The star-delta connection switching unit 160 also includes three pairs of fixed contacts 163a, 163b, and 163c for star-delta connection arranged at desired positions within a vertical movement zone of the star-delta connection-end vertical moving member 162 in such a fashion that the fixed contacts of each fixed contact pair are disposed at opposite sides of the vertical moving member 162, respectively. The fixed contacts 163a, 163b, and 163(0 163c . ranged at one side of the vertical moving member 162 are connected to the main starting terminals 122a, 122b, and 122c, respectively, while being insulated from one another. The fixed contacts 163a, 163b, and 163c arranged at the other side of the vertical moving member 162 are connected to the star-delta terminals 123a, 123b, and 123c, respectively, while being insulated from one another. Three pairs of moving contacts 164a, 164b, and 164c for delta connection are mounted to the star-delta connection-end vertical moving member 162 in such a fashion that the moving contacts of each moving contact pair are disposed at

opposite sides of the vertical moving member 162, respectively. The moving contacts 164a, 164b, and 164c arranged at one side of the vertical moving member 162 are insulated from one another. In similar, the moving contacts 164a, 164b, and 164c arranged at the other side of the vertical moving member 162 are insulated from one another. The moving contacts 164a, 164b, and 164c are vertically moved in accordance with a vertical movement of the vertical moving member 162, so that they selectively come into contact with respective associated ones of the fixed contacts 163a, 163b, and 163c, thereby causing the star-delta connection-end fixed contacts 163a, 163b, and 163c to be selectively connected to the starting terminal-end fixed contacts 163a, 163b, and 163c.

Three moving contacts 167a, 167b, and 167c for star connection are also mounted to the star-delta connection-end vertical moving member 162 above the delta connection-end moving contacts 164a, 164b, and 164c near the fixed contacts 163a, 163b, and 163c connected to th the r-delta terminals 123a, 123b, and 123c. The star connection-end moving contacts 167a, 167b, and 167c are short-circuited together. The moving contacts 167a, 167b, and 167c are vertically moved in accordance with a vertical movement of the vertical moving member 162, so that they selectively come into contact with respective associated ones of the fixed contacts 163a, 163b, and 163c, thereby causing the fixed contacts 163a, 163b, and 163c to be selectively

connected together. The star connection by the star connection-end moving contacts 167a, 167b, and 167c and the delta connection by the delta connection-end moving contacts 164a, 164b and 164c are achieved in an alternating fashion. For example, the star connection by the star connection-end moving contacts 167a, 167b, and 167c is achieved when the delta connection by the delta connection-end moving contacts 164a, 164b and 164c is released.

Return springs 165 are arranged around the star-delta connection-end moving core 161 between the upper surface of the star-delta connection-end electromagnet 140 and the lower surface of the star-delta connection-end vertical moving member 162 in order to provide a return force for returning the vertical moving member 162 to its original position at which the delta connection-end moving contacts 164a, 164b, and 164c are separated from respective associated ones of the fixed contacts 163a, 163b, and 163c. An arc prevention spring 166 is arranged in the star-delta connection-end vertical moving member 162 in order to always urge the delta connection-end moving contacts 164a, 164b, and 164c and the star connection-end moving contacts 167a, 167b, and 167c toward respective corresponding portions of the fixed contacts 163a, 163b, and 163c, thereby increasing the contact force of the delta connection-end moving contacts 164a, 164b, and 164c or the star connection-end moving contacts 167a, 167b, and 167c when the delta connection-end moving contacts

164a, 164b, and 164c or the star connection-end moving contacts 167a, 167b, and 167c come into contact with the fixed contacts 153a, 153b, and 153c, so as to suppress generation of arc at those contacts.

A timer 170 is arranged beneath the main circuit-end electromagnet 130 and star-delta connection-end electromagnet 140 in the interior of the body 110. The timer 170 serves to count an activation time of the main circuit-end electromagnet 130, thereby determining a point of time when the star-delta connection-end electromagnet 140 is to be activated. Isolating plates 180 are also arranged to isolate adjacent ones of the power terminals 121a, 121b, and 121c, adjacent ones of the main starting terminals 122a, 122b, and 122c, and adjacent ones of the star-delta terminals 123a, 123b, and 123c, respectively.

In the drawings, the reference numeral 191 denotes terminals to which power lines are coupled in order to supply current to the coils 132 and 142. The reference numeral 192 denotes bolts respectively coupled to the terminals 191 in order to provide an easy connection of the power lines to the terminals 191.

The electromagnetic switch device C for star-delta connections having the above mentioned configuration operates in a connection state, as shown in the equivalent circuit diagram of Fig. 4, in such a fashion that it establishes a star connection, when it is desired to start up the electric motor M,

in order to achieve a start-up of the electric motor M using starting current and starting torque reduced to a 1/3 level while switching the connection of the electric motor M to a delta connection after completion of the start-up of the electric motor M. For the best understanding of the present invention, elements of Fig. 4 respectively corresponding to those in Figs. 3a and 3b are denoted by the same reference numerals.

Now, the operation of the electromagnetic switch device C for star-delta connections according to the present invention will be described.

When current flows through the coil 132 of the main circuit-end electromagnet 130, which is constructed by the fixed core 131 and the coil 132, upon starting the three-phase electric motor M, the electromagnet 130 is magnetized by virtue of the current. Simultaneously with the magnetization of the electromagnet 130, the timer 170 begins to count the activation time of the electromagnet 130.

As the electromagnet 130 is activated, it generates a magnetm / etic . rce greater than the resilience of the return spring 155, so that the moving core 151 and vertical moving member 152 are downwardly moved. At the same time, the main circuit-end moving contacts 154a, 154b, and 154c are downwardly moved, so that they come into contact with the main circuit-end fixed contacts 153a, 153b, and 153c, respectively.

In such an initial state, the star-delta connection-end electromagnet 140 is maintained under a non-magnetization condition, that is, a condition in which no current flows through the coil 142. Accordingly, the star-delta connection-end moving coil 161 and star-delta connection-end vertical moving member 162 are maintained in a state in which they are spaced away from the coil 142 by virtue of the resilience of the return spring 165. In this state, the delta connection-end moving contacts 164a, 164b, and 164c are separated from the associated fixed contacts 163a, 163b, and 163c whereas the star connection-end moving contacts 167a, 167b, and 167c are in contact with the associated fixed contacts 163a, 163b, and 163c, that is, in a state short-circuited to the associated fixed contacts 163a, 163b, and 163c.

Accordingly, the three-phase electric motor M is in a star connection state, so that it is started up by electric power supplied via the three-phase power lines R, S, and T respectively connected to the power terminal 121a, 121b, and 121c.

After a predetermined period of time elapses, the timer 170 operates to allow current to flow through the coil 142 of the star-delta connection-end electromagnet 140. By virtue of the current, the star-delta connection-end electromagnet 140 is magnetized.

As the electromagnet 130 is activated, it generates a

magnetic force greater than the resilience of the return spring 165, so that the moving core 161 and vertical moving member 162 are downwardly moved.

At the same time, the star connection-end moving contacts 167a, 167b, and 167c are downwardly moved, so that they are separated from the associated fixed contacts 163a, 163b, and 163c, respectively. Also, the delta connection-end moving contacts 164a, 164b, and 164c are downwardly moved, so that they come into contact with the associated fixed contacts 163a, 163b, and 163c, respectively.

As a result, the main starting terminals 122a, 122b, and 122c are connected with the star-delta terminals 123a, 123b, and 123c, respectively, so that the three-phase electric motor M is switched to a delta connection state in which it is driven at a full speed.

Industrial Applicability

As apparent from the above description, the present invention provides an electromagnetic switch device for star-delta connections which includes two electromagnets arranged in its body and two switchingng us operating in accordance with respective magnetization states of the electromagnets in order to selectively establish a star connection or a delta connection for a three-phase electric motor. The electromagnetic switch device of the present invention can reduce installation costs

and an occupation space when it is applied to a star-delta starter. In addition, there is no unnecessary wiring. Accordingly, it is possible to reduce erroneous connections and erroneous operations.

Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. An electromagnetic switch device for star-delta connections comprising:

a body;

three power terminals arranged at one side of the body and respectively connected to three-phase power lines, the power terminals being insulated from one another;

three main starting terminals arranged at the other side of the body and respectively connected to one-side terminals of a three-phase electric motor, the main starting terminals being insulated from one another;

three star-delta terminals arranged at the other side of the body outside the main starting terminals and connected to the other-side ends of the three-phase electric motor, respectively, the star-delta terminals being insulated from one another;

an electromagnet for a main circuit and an electromagnet for star-delta connections disposesed a lower portion of the body in such a fashion that they are laterally aligned with each other while being insulated from each other, each of the electromagnets including a fixed core and a coil wound around the fixed core;

a main circuit switching unit arranged near the main circuit-end electromagnet in the interior of the body, the main

circuit switching unit serving to selectively connect each of the main starting terminals to an associated one of the power terminals in accordance with a magnetization of the main circuit-end electromagnet; and

a star-delta connection switching unit arranged near the star-delta connection-end electromagnet in the interior of the body, the star-delta connection switching unit serving to selectively connect the star-delta terminals to one another or to the main starting terminals, respectively, in accordance with a magnetization of the star-delta connection-end electromagnet.

2. The electromagnetic switch device in accordance with claim 1, further comprising:

a timer arranged in the interior of the body and adapted to count an activation time of the main circuit-end electromagnet, thereby determining a point of time when the star-delta connection-end electromagnet is to be activated.

3. The electromagnetic switch device in accordance with claim 1, further comprising:

isolating plates arranged between adjacent ones of the power terminals, between adjacent ones of the main starting terminals, and between adjacent ones of the star-delta terminals to isolate the adjacent power terminals, the adjacent main starting terminals, and the adjacent star-delta terminals,

respectively.

4. The electromagnetic switch device in accordance with claim 1, wherein the main circuit switching unit comprises:

a moving core vertically movable in accordance with a magnetization of the main circuit-end electromagnet;

a vertical moving member integrally coupled to the moving core in such a fashion that it is moved along with the moving core;

three pairs of fixed contacts arranged at desired positions within a vertical movement zone of the vertical moving member in such a fashion that the fixed contacts included in each of the fixed contact pairs are disposed at opposite sides of the vertical moving member, respectively, the fixed contacts arranged at one side of the vertical moving member being connected to the power terminals, respectively, while being insulated from one another, and the fixed contacts arranged at the other side of the vertical moving member being connected to the main starting terminals, respectively, while being insulated from one another; and

three pairs of moving contacts mounted to the vertical moving member in such a fashion that the moving contacts included in each of the moving contact pairs are disposed at opposite sides of the vertical moving member, respectively, the moving contacts arranged at one side of the vertical moving

member being insulated from one another, the moving contacts arranged at the other side of the vertical moving member being insulated from one another, and the moving contacts being vertically moved in accordance with a vertical movement of the vertical moving member, so that they selectively come into contact with respective associated ones of the fixed contacts, thereby causing the power terminal-end fixed contacts to be selectively connected to the starting terminal-end fixed contacts.

5. The electromagnetic switch device in accordance with claim 1, wherein the star-delta connection switching unit comprises:

a moving core vertically movable in accordance with a magnetization of the star-delta connection-end electromagnet;

a vertical moving member integrally coupled to the moving core in such a fashion that it is moved along with the moving core;

three pairs of fixed contacts for star-dm / -del(.. connection arranged at desired positions within a vertical movement zone of the vertical moving member in such a fashion that the fixed contacts included in each of the fixed contact pairs are disposed at opposite sides of the vertical moving member, respectively, the fixed contacts arranged at one side of the vertical moving member being connected to the main starting

terminals, respectively, while being insulated from one another, and the fixed contacts arranged at the other side of the vertical moving member being connected to the star-delta terminals, respectively, while being insulated from one another;

three pairs of moving contacts for delta connection mounted to the vertical moving member in such a fashion that the moving contacts included in each of the moving contact pairs are disposed at opposite sides of the vertical moving member, respectively, the moving contacts arranged at one side of the vertical moving member being insulated from one another, the moving contacts arranged at the other side of the vertical moving member being insulated from one another, and the moving contacts being vertically moved in accordance with a vertical movement of the vertical moving member, so that they selectively come into contact with respective associated ones of the fixed contacts, thereby causing the star-delta connection-end fixed contacts to be selectively connected to the starting terminal-end fixed contacts so as to achieve a delta connection; and

three moving contacts for star connection mounted to the vertical moving member at a position vertically shifted from the delta connection-end moving contacts near the star-delta connection-end fixed contacts, the star connection-end moving contacts being short-circuited together, and the star connection-end moving contacts being vertically moved in accordance with a vertical movement of the vertical moving

member, so that they selectively come into contact with respective associated ones of the fixed contacts, thereby causing the fixed contacts to be selectively connected together so as to achieve a star connection, the star connection by the star connection-end moving contacts being achieved when the delta connection by the delta connection-end moving contacts is released.

6. The electromagnetic switch device in accordance with claim 4 or 5, further comprising:

a return springs adapted to provide a return force for returning the vertical moving member to an original position thereof at which the moving contacts are separated from respective associated ones of the fixed contacts.

7. The electromagnetic switch device in accordance with claim 4 or 5, further comprising:

an arc prevention spring arranged in the vertical moving member and adapted to always urge the me mov contacts toward the fixed contacts, thereby increasing the contact force of the moving contacts when the moving contacts come into contact with the fixed contacts, so as to suppress generation of arc at regions where the moving contacts come into contact with the fixed contacts, respectively.

FIG. 1a

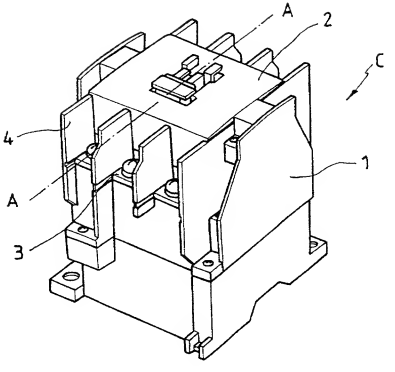


FIG. 1b

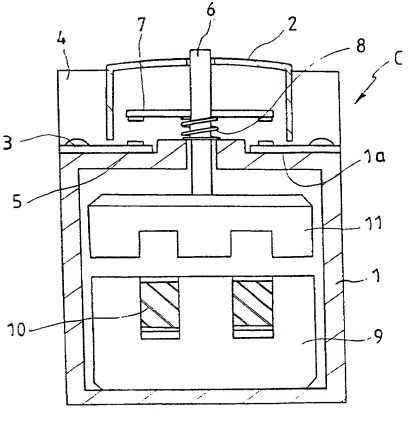


FIG.2

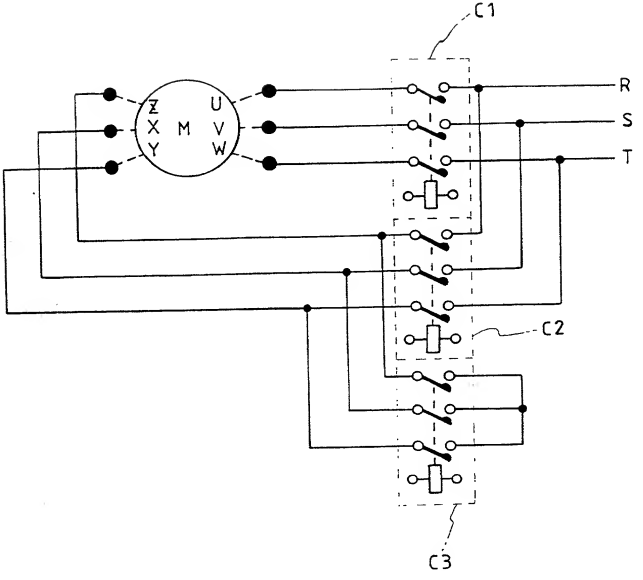


FIG.3a

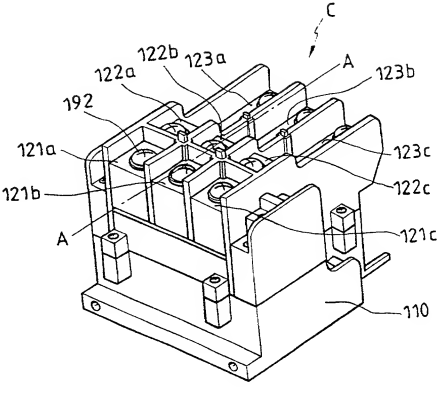
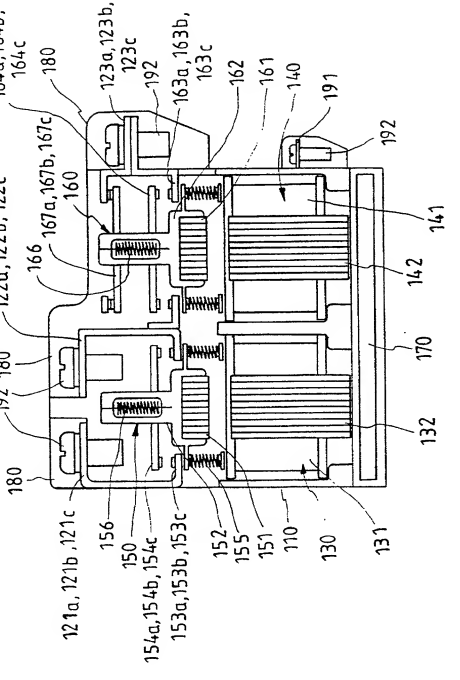


FIG.3b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164c
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123c
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163c
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170
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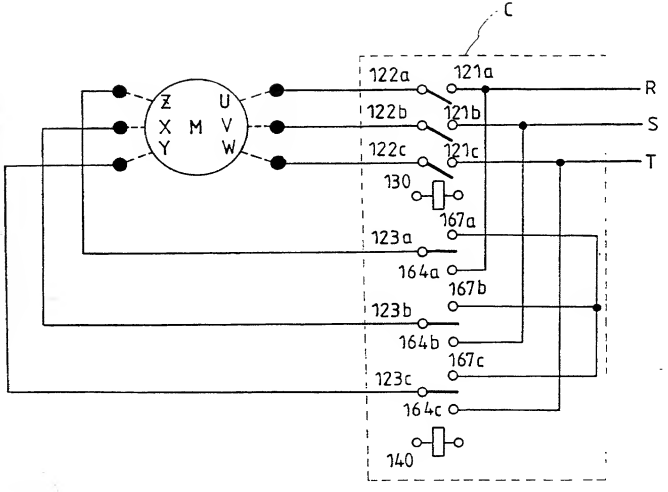
152
155
151
110
130
131

FIG .4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164b
167c
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164c
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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)	Attorney Docket Number	28490.2500
	First Named Inventor	PARK, Young Seo
	COMPLETE IF KNOWN	
☒ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required)	Application Number	/
	Filing Date	
	Group Art Unit	
	Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ELECTROMAGNETIC SWITCH DEVICE

the specification of which *(Title of the Invention)*

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) 01/20/2000 as United States Application Number or PCT International Application Number PCT/KR00/00039 and was amended on (MM/DD/YYYY) ______ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above:

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
1999/16761	KR (South Korea)	05/11/1999	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

10/031057

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DECLARATION ---- Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)
PCT/KR00/00039	01/20/2000	

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transmit all business in the Patent and Trademark Office connected therewith: ☐ Customer Number 20322 → *Place Customer Number Bar Code Label here*

OR ☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☒ Customer Number or Bar Code Label [ ] OR ☒ Correspondence address below

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Country		Telephone		Fax	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
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Post Office Address	Nam-ku						
City	Pusan	State		ZIP	608-091	Country	S. Korea

☐ Additional inventors are being named on the _____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached